Drones on the Rise: Societal Misperceptions of Small Unmanned Aircraft Systems (sUAS)

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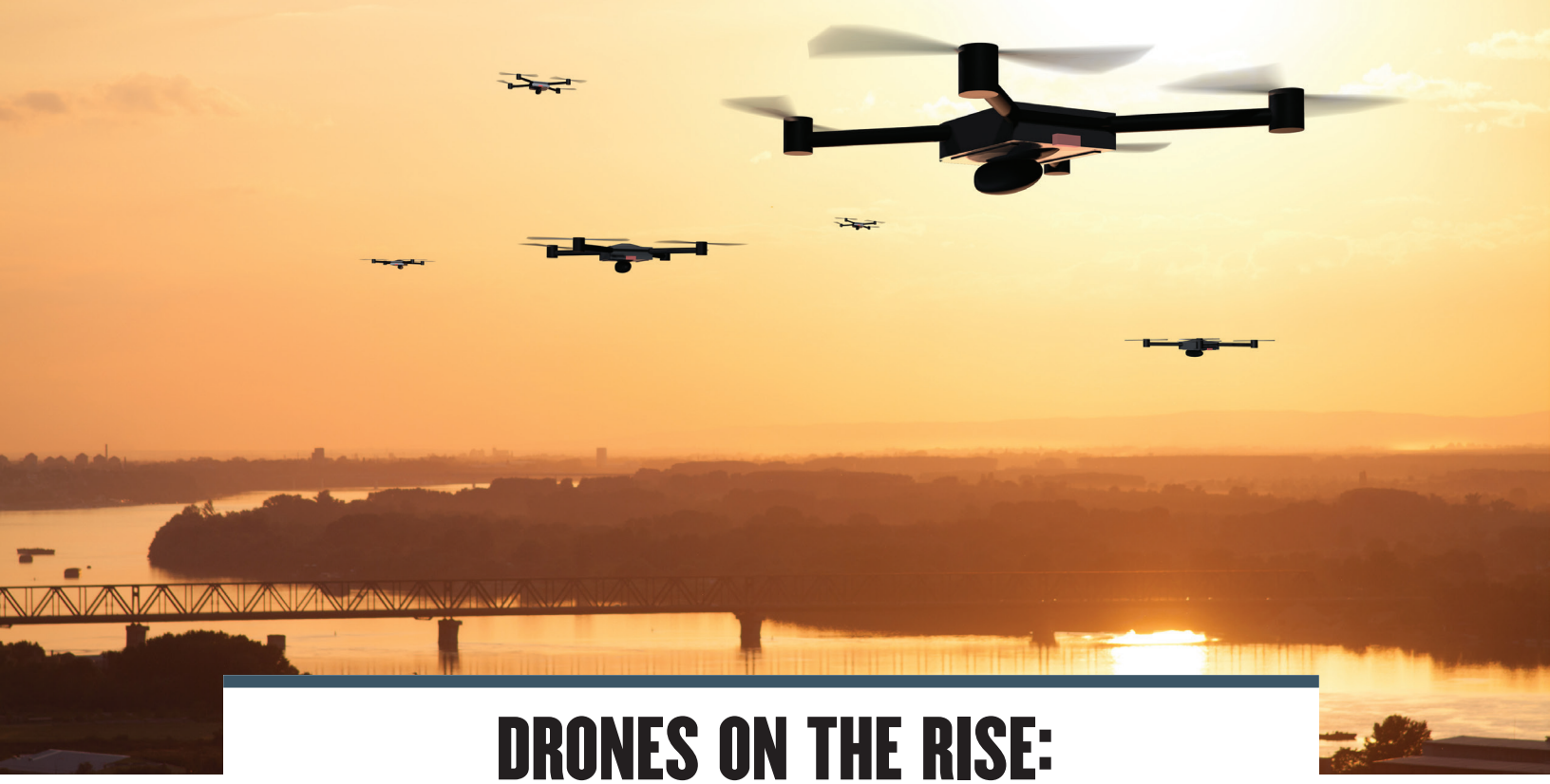

DRONES ON THE RISE:

Societal Misperceptions of Small Unmanned Aircraft Systems

Student Author

Renee Keilman is a first-year senior studying aeronautical engineering technology with a certificate in environmental and sustainable studies. She is passionate about the possibilities of combining these two fields in the hopes of making the aviation industry more environmentally sustainable. Keilman's research interests lie in alternative fuels, composite technologies, and the environmental impacts of the transportation sectors. Outside of her studies, she enjoys being outdoors, rock climbing, and horseback riding. Upon graduation, she will be pursuing a role as a design engineer with General Electric Aviation.

Mentors

Lisa Bosman, PhD in industrial engineering, is an assistant professor in the Department of Technology Leadership and Innovation at Purdue University. She is passionate about preparing students to enter the future workforce leveraging the endless possibilities for reinventing STEM education. Dr. Bosman's engineering and technology education research interests include the entrepreneurial mindset, self-regulated learning, civic engagement, and transdisciplinary education, to name a few. As a tech-based innovator, she is actively engaged in the local entrepreneurship community and regularly explores opportunities to integrate real-world projects into the classroom environment. Prior to joining academia, she spent the first part of her career working as a manufacturing engineer for world-class companies including Harley-Davidson, John Deere, and Oshkosh Defense.

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Abstract

Throughout the past decade, small unmanned aircraft systems (sUAS) have been on the rise in both the civilian and military sectors. It is forecasted that in the near future they will create thousands of jobs and billions in tax revenue due to their ability to execute difficult and hazardous tasks safely, efficiently, and cost-effectively. However, one current issue with the proliferation of the technology is a shortage of skilled employees due to a lack of education and common negative public misperceptions associated with them.

To investigate this, responses from a mixed-methods survey will be analyzed. Within the survey, questions such as participants' age, education level, current knowledge of sUAS, and interest in learning more about the technology were asked. The new knowledge we hope to create is a clearer understanding about the challenges and barriers regarding public perceptions of sUAS. The examination of data may reveal how stakeholders can better communicate to the public in hopes of building a skilled and educated workforce.

One approach to changing misperceptions about drones is through formal and informal educational initiatives, which can engage the public. The research will propose opportunities for higher education to play a role in educating the public through (1) aviation-focused after-school programs, (2) transdisciplinary/interdisciplinary courses and programs incorporating aviation, (3) the establishment of aviation minors and aviation university-level electives, (4) the development of informal aviation programs working with museums, and (5) the facilitation of summer aviation camps for high school students, to name a few.

Keywords

drones, sUAS, misperceptions, technology, society, cybersecurity

INTRODUCTION

The value of commercial applications of small unmanned aircraft systems (sUAS), or drones, rose from $40 million in 2012 to $1 billion by 2017 and is estimated to rise to $20 billion by 2026 (Cohn, Green, Langstaff, & Roller, 2017). The Association for Unmanned Vehicle Systems International forecasts the creation of over 100,00 jobs by 2025 as well as $635 billion in tax revenue between 2015 and 2025 (Association for Unmanned Vehicle Systems International, 2013). sUAS extend human potential, providing the instrument to execute difficult and hazardous tasks efficiently, safely, and cost-effectively and at lower risk levels (Association for Unmanned Vehicle Systems International, 2013). While the introduction of unmanned aircraft systems (UAS) into the national airspace system has opened up numerous possibilities, it has also created unique operational challenges, such as the establishment of regulations related to night flying, drone spraying, airspace height limitations, privacy issues, and the potential of using sUAS as a delivery option.

The Federal Aviation Administration (FAA) issues remote pilot certificates that allow certificate holders to get paid to operate sUAS. To be eligible, an applicant must be at least 16 years old and must be able to read, speak, write, and understand English; be in a physical and mental condition to safely fly a drone; pass the initial aeronautical knowledge exam; and undergo TSA security screening. However, a major current issue within the sUAS industry relates to a shortage of skilled employees, which is exacerbated by an underrepresentation among women, minorities, and individuals with disabilities. Furthermore, in preparing the future workforce, educational institutions continue to struggle with the challenge of responding to aviation-related educational, social, and economic trends at a national and global level. Anecdotal evidence suggests a high variance in public misperceptions related to sUAS regulations, functions, and applications. Figure 1 gives a representation of what the most common view of drone technology is portrayed as. However, for those people who understand the benefits of obtaining an aviation-focused bachelor's degree, slots are limited because the top programs, such as those offered through Purdue University and Embry-Riddle, are currently facing exponential growth in their cyclical aviation programs.

The purpose of this research essay is to investigate public misperceptions related to sUAS regulations, functions, and applications. From here, the essay proposes many different educational opportunities,

Figure 1. Example of a commercial UAS.

both informal and formal, to engage the public including youths through adults.

LITERATURE REVIEW

Challenges and Barriers to Communicating with the Public about Drones and UAVs

Clothier, Greer, Greer, and Mehta (2015) investigated the topic of unmanned aerial vehicles (UAVs), more commonly known as drones, and their rapid emergence within the aviation industry. Through their surveys of the Australian public, they found that many held a neutral attitude toward drones mainly due to their lack of knowledge on the topic. In this case neutral can be a challenge, because as public knowledge of the technology increases, this may change. Rao, Gopi, and Malone (2016) examined the idea that the application of drones for civilian use has the ability to alter several industries drastically as well as impact the way they are perceived by the public in how they can influence our daily activities. Chang, Chundury, and Chetty (2017) investigated the idea that with the rise of commercial drone usage there has been an increase in privacy and security concerns among the public. They conducted an study of 20 participants to analyze their perception of UAVs. McDougal (2013) investigated the emergence of UAVs in the commercial sector following their use in fighting the War on Terror. McDougal found that this transition to the commercial sector comes with many challenges regarding public perception and that the transition must be done carefully in order to capture the public's approval. Finn and Wright (2012) examined how the commercial use of drones for surveillance purposes may affect our personal civil liberties. They found that the regulations that are currently in place do not address these concerns adequately because of the complexity of the technology and the rapid rate at which it is growing in exposure. Kreps and Kaag (2012) investigated the debate that has arisen among many about the use of UAVs for military action. They found that the ethics of modern warfare have become questionable with the use of drones in the military. Kreps and Kagg also provide a philosophical framework that provides clarification to some of the debate that is taking place. Through a survey of 200 people, including laypersons and active drone users, Lidynia, Philipsen, and Ziefle (2017) investigated the views of the public in regard to their acceptance and what they perceive the barriers to UAV technology to be. They found that the diversity of the group they surveyed largely impacted both the categories of acceptance and the perceived barriers of drones. Additionally, many of the laypersons feared that their privacy is in violation with the usage of drones, whereas the active drone pilots saw more of a risk in the potential accidents that could occur. Bracken-Roche (2016) examined the necessity for regulation as drone technologies become more widespread. He found that the background of drones as objects used for surveillance reinforces the need for the discussion regarding surveillance concerns at the policy and regulation levels in order to minimize accidents and prevent harm. Boucher (2016) investigated the common public perception of civil drones among the public. He came to the conclusion that there is very little that is understood in regard to the public's reaction to them and that many of the decisions that are made about the technology have been based on untested assumptions. Kreps (2014) investigated how the use of drones as a symbol of American foreign policy has impacted the way they are perceive by the public. Kreps found that polls have indicated high levels of support for drone strikes despite controversy about the ethics and legality of the policies surrounding such strikes. Sakiyama, Miethe, Lieberman, Heen, and Tuttle (2017) examined the use of drones for domestic policing activities and the large concern that this brings regarding privacy and the intrusion on the daily lives of citizens. Through a study that Sakiyama et al. conducted, they found that public perceptions varied based on socioeconomic differences as well as many other factors.

Advantages and Benefits to Communicating with the Public about Drones and UAVs

Sandbrook (2015) investigated the perception around the use of drones for conservation efforts. Sandbrook found that the technology can be very beneficial to the efforts of conservation depending on how they can be regulated and if a good ethical practice of the technology can be ensured. Câmara (2014)

advocates the use of drones as a solution in scenarios of disaster to aid in search and rescue efforts. Many of the necessary technologies that can assist in these life-threatening situations are able to be utilized in a safer way through the use of drones. Not only would this application of drones have the potential to save many lives, it would also bring the technology into a new light among the public. Whetham (2013) investigated the moral ups and downs associated with the use of drones in the commercial space. Whetham dives deeper to understand the nuances regarding drones that are often overlooked. Kreps and Wallace (2016) investigated whether critical views from international legalities regarding the U.S. military's drone usage can have a negative impact on the local public's perception. Through a series of surveys, they found that the usage of drones to fight terrorism brought much debate throughout the public. Fortunati, Esposito, and Lugano (2015) provide insight on the use of industrial and domestic robots, including drones and what impact they may have on contemporary society in the future. Although use of robots in industrial settings is not a new concept, the use of them domestically is still an unsettled area of research that is being conducted. Clarke (2014) provides an explanation of the fundamentals of drone technologies and their uses in the 21st century. Clarke found that careful consideration is necessary to ensure that public safety and behavioral policies are put in place as they are with other forms of aircraft. Klauser and Pedrozo (2017) investigated the public perception of hobby and commercial drone usage in Switzerland. They found that the driving forces and obstacles in which current drone development is occurring shape the way In which the aerial realm is perceived and the risks and opportunities that are associated with it. Karlsrud and Rosén (2013) examined the position that drone technology has in the United Nations peacekeeping missions around the globe. They found that there are many reasons that drones are beneficial for surveillance missions, as they are able to inform leadership and provide situational awareness. But they are met with much skepticism by humanitarian groups that question their privacy rights as well. Vergouw, Nagel, Bondt, and Custers (2016) investigate the different uses for drones and how this impacts the regulations that should be applied to the different categories. They found that over the past decade, the emergence of drones in the public space has increased dramatically, and thus the public should be prepared. Wang, Xia, Yao, and Huang (2016) through a series of surveys investigated the public perception of drones for many different uses. They found that there is not much known about what the technology is capable of and what it is currently being used for, but nonetheless, many were still skeptical.

Public Perceptions Related to Drones and UAVs

Thompson et al. (2018) analyzed the common misconceptions that students have about cybersecurity, including drones, and found that biases, incorrect assumptions, overgeneralizations, and conflicting concepts were common themes in the interviews they conducted. On the other hand, Luppicini and So (2016) outline the key areas of ethical and social concerns that the public is most aware of in respect to drone technology. Much of the public knowledge of the area comes from the media, which can often skew one's perspective by not providing the whole context of a topic. The purpose of this essay is to investigate public misperceptions related to sUAS regulations, functions, and applications. From here, the essay proposes many different educational opportunities, both informal and formal, to engage the public, from youths through adults.

METHODS

Research Instrument

A mixed-methods survey approach was adopted for the study. The research instrument used in data collection consisted of six sections: consent and demographic information, general knowledge, trust utilization, safety risk benefits, applications, and open-ended questions.

Upon obtaining Institutional Review Board (IRB) approval, the survey was distributed using an online survey tool, Amazon Mechanical Turk®. The survey tool service connects researchers to the public for completion of research surveys. A convenience sampling method targeted those who were at least 18 years of age. Respondents were required to consent to the terms of the IRB protocol and were paid after completion of the survey. The data-collection period was February 2017 to March 2017.

Participants

Males made up 51% (n = 539) of respondents, while 46% (n = 488) were women, and .01% (n = 13) preferred not to mention their gender. Regarding the highest level of education attained by respondents, 27.9% were high school graduates or earned a General Education Development (GED) degree, 18.6% had an associate (two years of college) degree, 39.4% had a bachelor's degree; 11.3% had a graduate or professional degree or higher; and 2.9% had other qualifications or preferred not to say. The survey targeted a wide range of age groups, with the dominant groups falling between 23 and 47 years old.

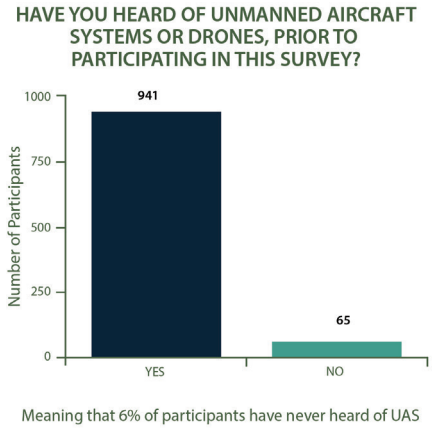

Figure 2. Survey question assessing if participants had heard of UAS prior to the survey.

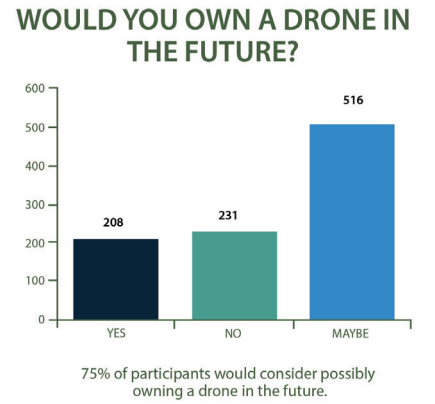

Figure 3. Survey question assessing participant interest in owning a drone in the future.

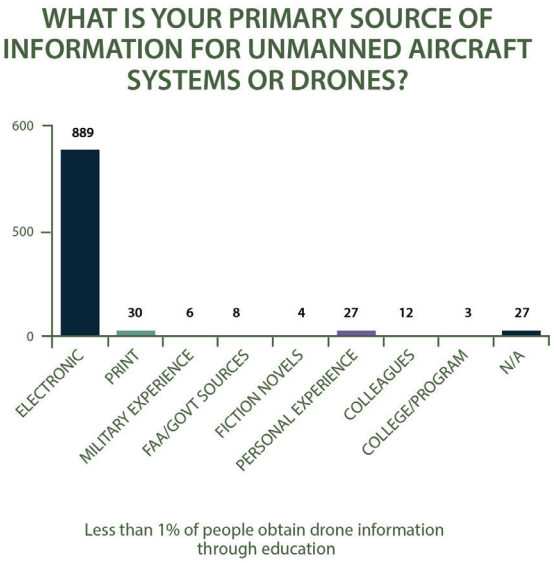

Figure 4. Survey question assessing where participants receive UAS information.

RESULTS AND DISCUSSION

This section provides a summary of the key findings related to risk, regulation, level of automation, and applications.

Figure 2 provides results related to the question "Have you heard of unmanned aircraft systems or drones prior to participating this survey?" In response, 94% of participants said yes, they had heard of UAS or drones before; however, 6% of participants had not heard of UAS or drones before. It is surprising that 6% of people haven't heard of drones, given their widespread coverage by the media.

Figure 3 provides results related to the question "Would you consider owning a drone in the future?" In response, nearly 75% of participants said yes, they would consider owning a drone in the future; however, 24% of participants definitively would not consider owning a drone. It is surprising that a majority of participants would consider owning a drone when participant knowledge prior to the survey was seen to be limited.

Figure 4 provides results related to the question "What are [participants'] primary sources of information for Unmanned Aircraft Systems or Drones?" In response, nearly 89% of participants gained their knowledge of UAS through media and electronic means. Furthermore, less than 1% of participants gained their UAS knowledge through educational means.

Figure 5 provides results related to whether participants were familiar with policies relating to UAS operations. In response to the statement "Special approval from the FAA is required to legally operate Unmanned Aircraft Systems in the United States (True/False)," nearly 35% of participants responded that they were unsure of what the policy contains, showing that there are public misconceptions related to UAS policies and regulations. Additionally, in response to the statement "Most unmanned aircraft systems currently in use are capable of operating completely autonomously without any human controller (True/False)," about 31% of participants indicated that they were unsure, thus indicating that there are misperceptions related to autonomous use.

Figure 6 provides results related to the question "Are there appropriate federal authorities to regulate the operations of Unmanned Aircraft Systems?" In response, nearly 42% of participants said that they were unsure what authorities regulate

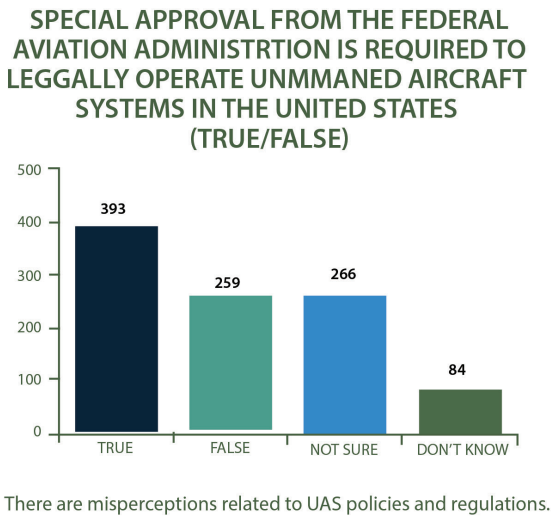

Figure 5. Survey question assessing participant knowledge of UAS policies.

UAS operations. This indicates that there are misperceptions among participants concerning UAS policies and regulations.

Figure 7 provides results related to the question "How would you vote on legislation to allow unmanned aircraft systems to operate in your city over public properties?" In response, nearly 46% of participants said that they would vote yes on such a regulation, nearly 40% indicated that they would vote no on this, and 14% stated that they would not vote at all. The results of this question indicate that there are

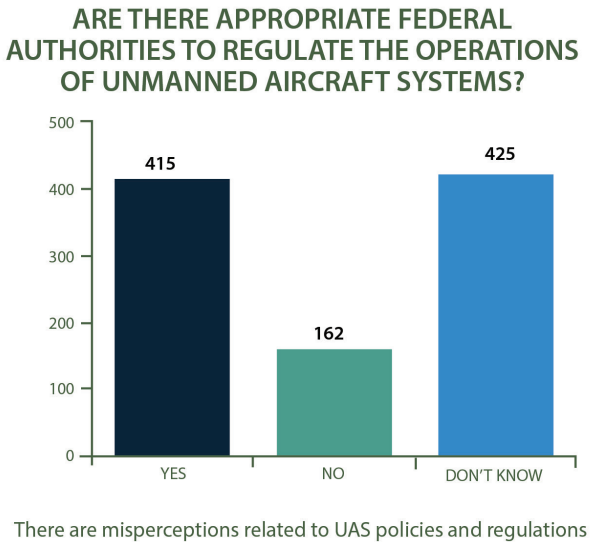

Figure 6. Survey question assessing participant knowledge of UAS regulations.

public differences in how participants would vote on possible UAS legislation.

Figure 8 provides results related to the question "Do you trust federal agencies to adequately regulate the operations of Unmanned Aircraft Systems?" Participants were almost equally divided, with the answers yes, they would trust a federal agency; no, they would not trust a federal agency; and unsure. These results indicate a difference in opinion related to federal agencies and authorities and UAS operations.

Figure 9 provides results related to the question asking participants to rate on a scale whether or not they strongly agree to strongly disagree to the following two statements: "The Unmanned Aircraft Systems technology is safe (does not endanger human life and properties) (Agree or Disagree)" and "The Unmanned Aircraft System technology is beneficial to society (Agree or Disagree)." In response to the first statement, a majority of participants replied that they are neutral as to whether UAS technology was safe. The remaining participant votes were split between whether they believed that the technology was safe or not. In response to the second statement, nearly 55% of participants agreed that UAS technology is beneficial to society and disagreed that the technology is threatening.

Figure 10 provides results related to the question "To what extent do you trust researchers and academia operators of Unmanned Aircraft Systems to be safe?" In response, a majority of participants would trust UAS technology when operated by researchers and academia personnel in comparison to the government or corporations.

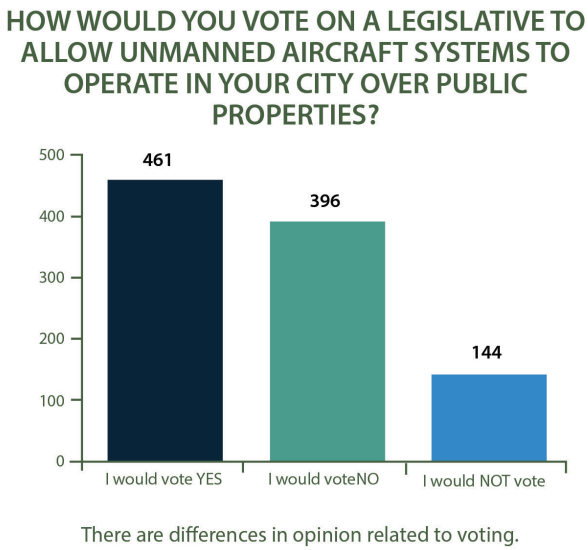

Figure 7. Survey question assessing participant interest on UAS legislation.

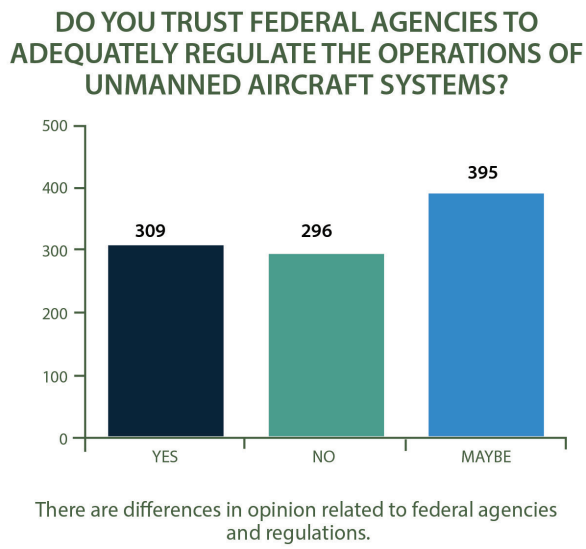

Figure 8. Survey question assessing participant trust of federal agencies for UAS regulations.

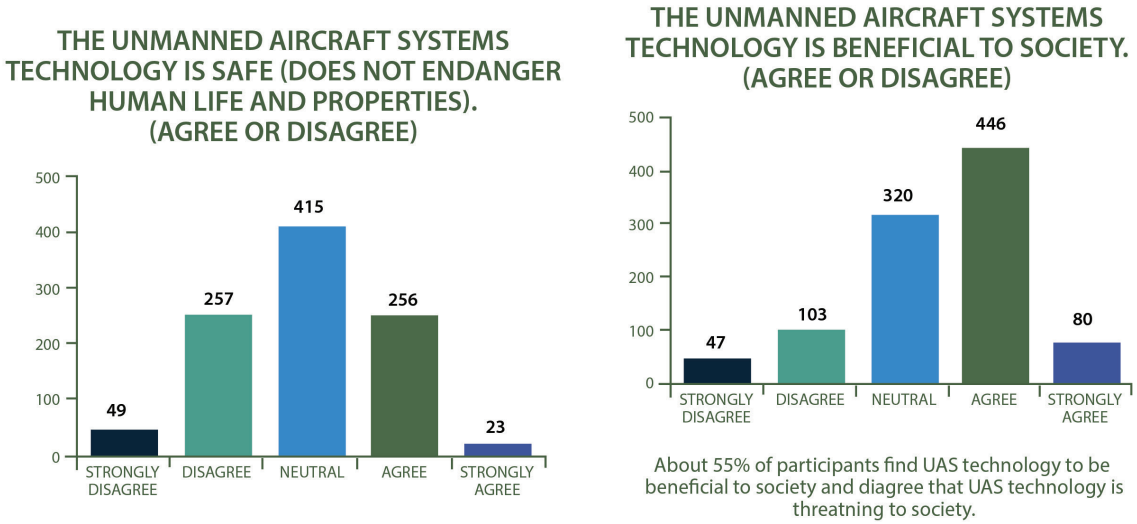

Figure 9. Survey question asking participants if they believe that UAS technology is safe/beneficial to society.

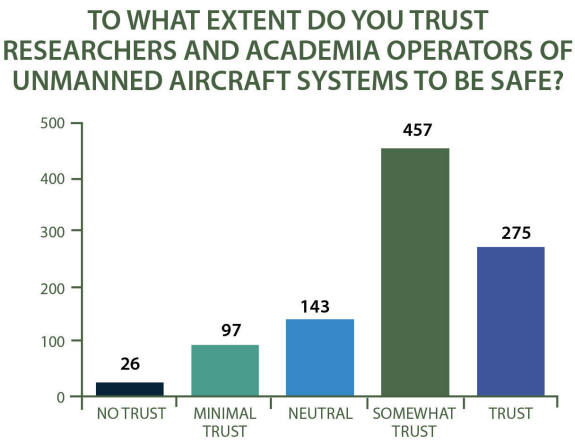

Figure 10. Survey question assessing participant trust of researchers and academia in the use of UAS.

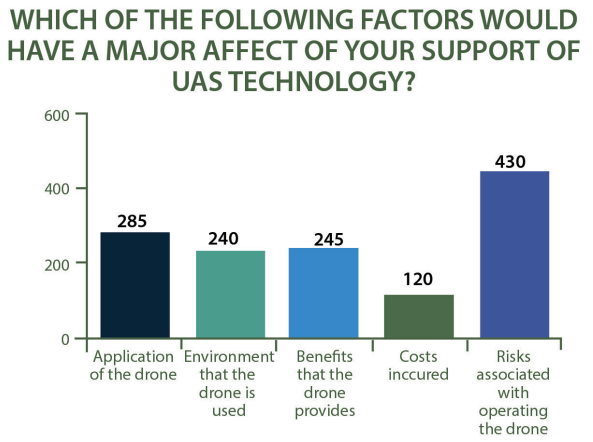

Figure 11. Survey question assessing which factors would have a major impact on participant support of UAS technology.

Figure 11 provides results related to the question "Which of the following factors would have a major effect of your support of UAS technology?" For participants, the cost of the technology had the least effect on their support for the technology. Furthermore, the risks, benefits, and application of the drone as well as the environment that it operates in all had a considerable effect on participants' support for UAS technology.

Figure 12 provides results related to the question "Which of the following best represents your opinion toward Unmanned Aircraft Systems?" In response, a majority of participants indicated that their opinion was dependent on the circumstance in which the UAS technology was being used. Nearly 15% of participants indicated that they had a firm opinion either for or against the technology.

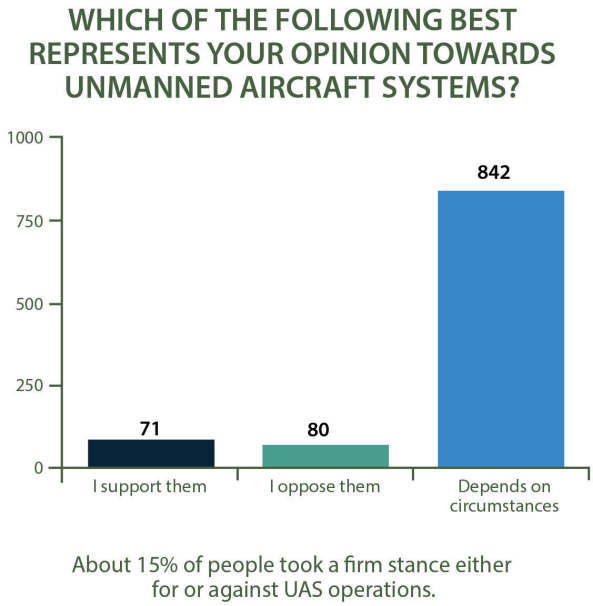

Figure 12. Survey question assessing participant opinions of UAS.

CONCLUSION

The findings suggest that there are many public misperceptions related to drones. The author proposes higher education needs to play a major role in educating the public related to the following interventions: (1) aviation-focused after-school programs, (2) development of new interdisciplinary/ transdisciplinary courses and programs incorporating aviation, (3) establishment of aviation minors and aviation university-level electives, (4) development of informal aviation programs working with museums, and (5) facilitating summer aviation camps for high school students.

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